A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

April 1971

U.S.

NATIONAL BUREAU OF STANDARDS

Technical News Bulletin

UNITED STATES DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

Technical News Bulletin

APRIL 1971 / VOL. 55, NO. 4 / ISSUED MONTHLY

U.S. DEPARTMENT OF COMMERCE
Maurice H. Stans, Secretary
James H. Wakelin, Jr., Assistant Secretary for Science and Technology
NATIONAL BUREAU OF STANDARDS
Lewis M. Branscomb, Director

CONTENTS

91 Magnetic and Optical Studies of Ruby
92 Magnetometer for Use at Very Low Temperatures and High Magnetic Fields
93 FIPS Notes
96 NSRDS News
98 Standards and Calibration
100 Superconducting Device Measures Heartbeat Magnetically
102 Fluorescence Yields Measured for Light Elements
103 Universal Testing Machine Errors Measured
104 Standard Reference Materials
106 New Sulfur Dioxide Permeation Tube
107 Magnetic Tape Cassette Program Initiated
107 Additional Interlaboratory Programs for Rubber
108 Acoustic Formulas Predict Propagation Instability
109 Conference and Publication Briefs
110 NBS Makes its First Measurements of Transition Probabilities in VUV
111 Publications of The National Bureau of Standards

COVER: *A magnetic susceptibility technique has been used to determine the concentration of Cr^{3+} in ruby. Here George Candela alines a ruby prior to measurement.*

Nat. Bur. Stand. (U.S.), Tech. News Bull.
CODEN: NBSTA 55(4) 89-112 (1971).
Superintendent of Documents Catalog No. C13.13:55/4.
Library of Congress Catalog No. 25-26527.

Prepared by the NBS Office of Technical Information and Publications, Washington, D.C. 20234
W. R. Tilley, Chief

Managing Editor
D. V. Baker
Contributing Editors
L. K. Armstrong, R. T. Cook, D. K. Coyle, J. E. Kluge, C. R. Naas, A. Schach, C. N. Smith, D. E. Webb

G. J. Connell, Visual Editor

The National Bureau of Standards serves as a focal point in the Federal Government for assuring maximum application of the physical and engineering sciences to the advancement of technology in industry and commerce. For this purpose, the Bureau is organized as follows:

- The Institute for Basic Standards
- The Institute for Materials Research
- The Institute for Applied Technology
- Center for Radiation Research
- Center for Computer Sciences and Technology

The TECHNICAL NEWS BULLETIN is published to keep science and industry informed regarding the technical programs, accomplishments, and activities of NBS.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Annual subscription: Domestic, $3; foreign, $4; single copy, 30 cents. Use of funds for printing this publication approved by the Director of the Bureau of the Budget (June 22, 1966).

Close-up of a ruby crystal in quartz holder.

MAGNETIC AND OPTICAL STUDIES OF RUBY

A MAGNETIC SUSCEPTIBILITY TECHNIQUE has been used to measure the Cr^{3+} concentrations in samples of ruby (chromium in corundum ($a-Al_2O_3$)).[1] Susceptibilities were measured by the Faraday method both with and without selective microwave saturation of the Cr^{+3} susceptibility at spin resonance. The susceptibility values were used to calculate the Cr^{3+} concentrations, and these together with the optical absorption of the same samples were used to obtain the molar absorption coefficients. Also, the susceptibility was unchanged after γ-irradiation, indicating that, within experimental error, no change in the concentration of the Cr^{+3} had occurred. This work by Robert F. Blunt, George A. Candela, Richard A. Forman, and Arnold H. Kahn of the NBS Institute for Materials Research, and B. W. Mangum of the NBS Institute for Basic Standards, was supported in part by the Advanced Research Projects Agency.

In studies of the optical absorption due to defect centers in crystals, a knowledge of the concentration and the optical absorption spectrum of the centers is desired. In many systems the more difficult measurement is that of the number of centers, and this measurement can involve the largest error. The method developed may be used to obtain concentrations of paramagnetic centers to accuracies equal to or exceeding those obtained by optical absorption methods.

The technique used consists of measurements of the static magnetic susceptibilities with and without selective microwave saturation of the paramagnetic resonance of the magnetic center. At microwave saturation the susceptibility arising from the paramagnetic centers is zero due to equilization of the populations of all the spin states. This method is quite selective as the only spins saturated are those which satisfy the proper resonance condition and have a sufficiently long relaxation time. In most cases this would serve to select a particular valence state and site symmetry of the center.

The correlation of the above results with the optical absorption data constitutes a new determination of the Cr^{3+} optical absorption coefficients in ruby. The absorption coefficient of 50 cm^{-1} (per weight percent equivalent Cr_2O_3) for both the 0.40 and 0.56 μm band maxima was obtained with the light parallel to the optic axis.

Interest in the causes of the orange color of x-ray and γ-irradiated ruby suggested that susceptibility measurements be taken on irradiated samples. It was found that within experimental error the magnetic susceptibility was unchanged (reproducibility of the measurements is 0.5 percent). It does seem most unlikely that any appreciable change in the Cr^{+3} centers originally present would result in a net negligible over-all susceptibility change. Thus, the most likely inference is that irradiation does not alter the number of chromium ions having 3+ valency by more than 1 percent.

[1] Blunt, R. F., Candela, G. A., Forman, R. A., Kahn, A. H., and Mangum, B. W., Magnetic susceptibility and optical studies of Cr^{3+} in Al_2O_3 (ruby); a magnetic method for determining concentration, J. Appl. Phys., in press.

MAGNETOMETER FOR USE AT VERY LOW TEMPERATURES AND HIGH MAGNETIC FIELDS

A HIGH-SENSITIVITY VIBRATING-SAMPLE MAGNETOMETER has been developed for use at very low temperatures and in high magnetic fields.[1] The device, developed by B. W. Mangum and D. D. Thornton, is sufficiently compact to be placed in a ^{3}He cryostat or a ^{3}He-^{4}He dilution refrigerator which in turn can be placed between the poles of an electromagnet. The magnetometer should prove highly useful for studies of magnetic properties of materials at extremely low temperatures.

Basically the apparatus operates by vibrating the sample inside a pick-up coil, thereby producing an electrical output. The output is then evaluated to yield the magnetic characteristics of the sample. A principal feature of the magnetometer is a piezoelectric vibrator,[2] one end of which is clamped to a phenolic support so that it operates as a cantilever. A phenolic-resin holder, on which the sample is mounted, is bonded to the other end of the vibrator. The vibrator is operated near its fundamental mechanical resonance, which corresponds to simple flexing. Since it is desirable to operate the magnetometer at a fixed amplitude of vibration at all temperatures, an additional pick-up coil and reference sample has been incorporated to monitor the vibration amplitude. The monitoring signal is produced by mounting a polycrystalline yttrium iron garnet (YIG) sphere on a post attached to the vibrator, with the YIG sample located in the center of a reference coil-pair. By monitoring the signal from the YIG sample, whose magnetization is essentially independent of temperature at a fixed applied field, a constant amplitude of vibration can be maintained by varying the voltage to the vibrator. At a frequency of 210 Hz, approximately 10 percent above the fundamental mechanical resonance of the magnetometer described here, the YIG signal changed by only 1.5 percent from 4.2 to 0.3K without any adjustment of the drive voltage.

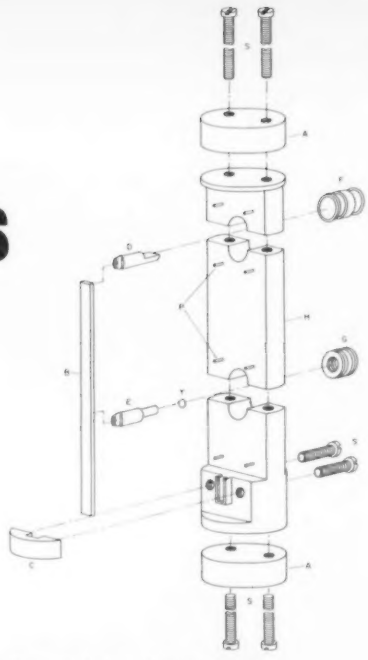
In operation, the vibrator is driven (normally at 0.1 to 1.0 volt) by the reference output of a phase-sensitive detector. The signal from the sample pick-up coils is fed to the phase sensitive detector and is then displayed as the ordinate on an X–Y recorder. A voltage directly proportional to the applied magnetic field is used as the abscissa. The resulting plot represents the magnetic characteristics of the material.

The sensitivity of the magnetometer is 10^{-6} emu, and the noise level of the coils was unchanged when magnetic fields of magnitude up to 2.2 tesla were applied.

The heating due to the entire assembly is very small. An upper limit on the heating caused by flexing of the vibrator is about 10^{-9} watt. Even at the lowest temperatures, where the system was most sensitive to heating effects, there was less than 1 mK change when a drive voltage of 1.0 volt was applied, indicating that the heat generated in the vibrator from all sources present was less than 10^{-7} watt.

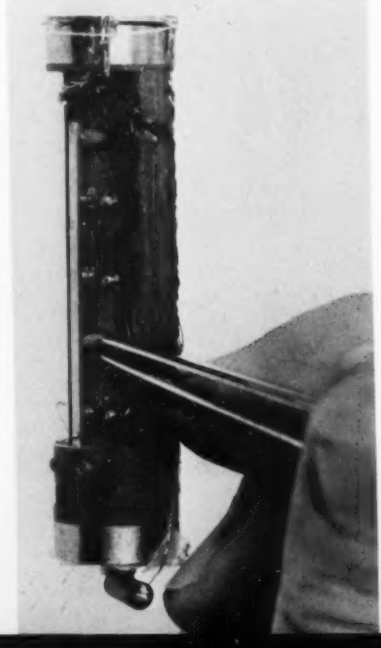
[1] For further details, see Manoum, B. W., and Thornton, D. D., Vibrating sample magnetometer for use at very low temperatures and in high magnetic fields, Rev. Sci. Instrum. 41, No. 12, 1764–1766 (Dec. 1970).

[2] Gubser, D. V., and Mapother, D. E., Remotely controlled piezoelectric vibrator for low temperature applications, Rev. Sci. Instrum. 40, No. 6, 843 (June, 1969).



Expanded view of the magnetometer developed for use at extremely low temperatures and high magnetic fields. The vibrator B is clamped at end C such that it acts as a cantilever. The sample is mounted on its holder D which then vibrates inside the pick-up coils F. An yttrium iron garnet sphere Y and its pick-up coils G serve to monitor and control the amplitude of the vibrator. Other components are: brass end plates A, connecting terminals P, magnetometer support H, and nonmagnetic screws S.

Close-up photograph of the magnetometer shows arrangement of the cantilever, reference sample holder (tweezers), and sample holder (end of cantilever).



FIPS NOTES

EFFECTIVE COMMUNICATION of data among computer centers and remote terminals is essential to maximum utilization of current data processing resources. However, there are significant compatibility problems to be solved due to the broad differences inherent in existing ADP and communications systems and equipment. Steps are being taken to solve these problems by identifying and developing uniform standards and practices. Representatives from NBS and other government agencies are contributing to the solution through sponsorship of and participation on Government and industry standards groups in this area. A review of current efforts and the 30 some standards processed should be of interest to the entire information processing and communications community.

To an increasing extent telecommunication [1] networks, data links and communication terminal facilities are being employed with computers. Based upon the Fiscal Year 1970 Federal Government ADP Inventory, there are estimated to be 1100 computers and 3000 terminal equipments involved in teleprocessing operations employing data communications facilities. It is projected that by FY 1975, 95 percent of the inventory (or 10,000 computers) may be involved with teleprocessing. Such computer applications, involving communication networks and facilities, may be classified according to one of two general categories:

1. Those computer applications that are concerned with the use of computers as a part of the communications function, for network control, circuit or message switching, or customer billing operations.

2. Those computer applications that employ data communications facilities and networks to provide information interchange to remote locations.

The first application category is the principal concern of the communication system specialist in that computers are employed primarily in support of the communications function. The second category, frequently referred to as teleprocessing, is primarily the responsibility of the information processing system designer and ADP specialist; here, communication facilities are used to support the computer users' requirements for the remote processing and interchange of information. Personnel employed in either application category generally require varying degrees of interdisciplinary knowledge of both technologies—computer and communications. This is particularly true in the areas of system design practices, operating procedures and standards.

The organizations that have been established to deal with standards development for the telecommunications technology are both older and separate from those corresponding organizations established for information processing standardization.[2] Furthermore, because of fundamental differences between the industries servicing these technologies as well as differences between the populations of users, there are significant differences in both the standards development and implementation processes. However, because of the increasing interaction between computer and communication systems there is a growing awareness of the need for consistent procedures and common practices between these two technologies, particularly with respect to data communication standards. As a result, both technologies have established formal standards coordination and review arrangements among their respective trade associations, industry groups, and national and international organization dealing with data communication standards. Various informal coordination arrangements have also been evolved by individuals who cross the technological boundary to participate in both communications and computer standards activities. The standards making bodies concerned with data communications standardization as well as some of the more formal coordinating arrangements among them are outlined in Figure 1 and briefly described below.

ANSI SUBCOMMITTEE X3S3

Within the American National Standards Institute (ANSI), under Sectional Committee X3, on Computers and Information Processing, Subcommittee X3S3 is responsible for defining the characteristics of digital data generating and receiving systems that function with communication systems and for developing and recommending standards for data communications. Four Task Groups have been established under X3S3 with the following responsibilities:

Task Group X3S33 is responsible for standardizing data communication formats. Its two-fold scope of activities are to define formats for data communication of bits within characters and of characters within a hierarchy of groups, and functional control requirements and procedures for data systems other than required for control of a data link.

X3S34, responsible for developing standard data communication control procedures, is engaged in three projects with the following objectives:

(1) To establish a set of standard code-

dependent data communication control procedures based on the ten ASCII communication control characters covering data communication links with one-way only, two-way alternate and two-way simultaneous transmission capabilities.

(2) To establish a set of standard, code-independent data communications control procedures for efficient transmission of both binary and coded data; link control based upon sensitivity to binary control sequences and positional bit significance in contrast to fixed (ASCII) code.

(3) To study and recommend areas of standardization in data communication networks.

X3S35 is responsible for standardizing data communication system performance measurement techniques and criteria with the specific objectives of defining the nomenclature, presentation and measurement of those characteristics which determine the performance of general purpose digital data communication systems.

X3S36 is responsible for establishing standard signalling speeds with the objective of defining digital data signalling rates at the interface between data terminal and data communication equipment.

EIA TR29, TR30 AND TR37

The Electronic Industries Association (EIA) is the national organization of electronic manufacturers in the United States. It is a trade association member of the American National Standards Institute, sponsoring the X6 Committee of ANSI (Computers and Related Equipment) and participating jointly under X3 on the X3S3 level in the development of American National Standards for data communications. Within EIA there are three engineering committees concerned with developing industry standards for data communication and related areas as follows:

Committee TR–29 is concerned with facsimile systems and equipment. Its scope of interest includes the development and maintenance of standards for the interface between communication and facsimile terminal equipment and other standards describing the characteristics of the facsimile terminal equipment. This includes work on:

(1) The interface between signal converters (modems) and facsimile terminal equipment.

(2) Terminal equipment characteristics which insure that a transmitter provided by one supplier will communicate successfully with a receiver provided by another.

TR–30 is responsible for the development and maintenance of industry standards for the interface between data communications and data terminal equipment. This includes work on:

(1) The interface between digital data terminal equipment and signal converters, data sets or modems.

(2) Signal quality at the interface.

(3) Data signalling speeds.

(4) Liaison and cooperation with ANSI Subcommittee X3S3 on data transmission standardization. This is accomplished by holding joint meetings with X3S3.

TR–37 is responsible for the development and maintenance of standards for the interface between common carrier provided connecting arrangements and customer provided communication equipment and systems. This includes work on:

(1) Data graphic and voice communication systems.

(2) The interface between common carrier provided electrical coupling units and customer provided data sets, modems or voice terminal equipment.

(3) Acoustic and inductive coupling between common carrier provided telephone instruments and customer provided data sets, modems or voice terminal equipment.

INTERNATIONAL DATA COMMUNICATION STANDARDIZATION

ISO/TC97/SC–6: Internationally, there are a number of organizations involved either directly or indirectly with the development of data communication standards. Foremost among these is the International Organization for Standardization (ISO), Technical Committee (TC) 97, Subcommittee (SC) 6 concerned with digital data transmission. Membership in this Subcommittee, as in all ISO activities, is provided by the national standards bodies of the participating countries. United States participation is provided by ANSI X3S3. The scope and program of work of this group includes the continual surveillance of the telecommunication environment as it affects the development of data communication standards and the ability to build, install, operate and maintain data processing systems which use telecommunications. This surveillance includes monitoring the technologies employed by the member country common carrier and Postal Telephone and Telegraph services so as to take into account the communications environment in developing standards and to react when these services do not meet the requirements of the data processing community.

ITU: The International Telecommunications Union (ITU) is an intergovernmental organization concerned with establishing international agreements, treaties and standards, with respect to telecommunication. It seeks to coordinate the works of national governments and private bodies by promoting the development of technical facilities and their efficient operation, and to improve the efficiency and usefulness of telecommunication services and make them, as far as possible, generally available. The ITU studies technical, operating, and tariff questions relating to telecommunications, makes recommendations, and collects, publishes and disseminates information for its membership. The Union participates in the United Nations (UN) Expanded Program of Technical Assistance, and the UN Technical Assistance Program, and acts as an executive agent for telecommunication projects financed by the UN Special Fund in various countries.

CCITT (ITU): The Consultative Committee on International Telegraph and Telephone (CCITT) is a technical group operating under the ITU established to examine and make recommendations on technical, operational, and tariff matters relating to telegraphy, facsimile, and telephony. CCITT membership is made up of five categories as follows:

(1) Member country telecommunication administrations—A members.

(2) Recognized private agencies such as the American Telephone and Telegraph Company—B members.

(3) Scientific or industrial organizations such as equipment manufacturer associations—C members.

(4) International organizations such as the International Civil Aviation Organization (ICAO) and the International Organization for Standardization (ISO)—D members.

(5) Specialized agencies operating in related fields such as the World Meteorological Organization (WMO)—E members.

Only A-type members have voting powers at the Plenary sessions where decisions are made. The United States is represented on CCITT by the Department of State with the Federal Communications Commission and the Office of Telecommunications Policy being their principal consulting agents. In addition, United States positions to be represented at CCITT meetings are determined by Preparatory Group meetings held by the Department of State, to which all interested parties are invited. Coordination in the area of data communications standards in CCITT affairs is accomplished through direct participation of C and D type members that include ISO and the European Computer Manufacturers Association (ECMA).

The CCITT program of work is divided over some 25 study groups, working parties and area plan committees which discuss and prepare the detailed recommendation in their particular areas of specialty. The three groups which are of prime interest to the data communications community are:

Special Study Group A, Data Transmission, is the principal point for the data

processing community contacts with CCITT. The work program includes all matters relevant to data transmission including interfaces, modems, and maintenance procedures.

Joint Working Party ALP—Alphabet, is responsible for all work on alphabets and codes including the transmission aspects such as character structure and keyboards.

Joint Working Party NRD—New Data Networks, is responsible for working on new data networks with the emphasis being upon digital networks for data transmission and related uses. As such it will have an important impact upon the data processing community in the future.

EXISTING DATA COMMUNICATION STANDARDS AND RECOMMENDATIONS

A listing of the approved national (ANSI) and industry (EIA) standards, plus international recommendations of ISO and CCITT relating to data communications, is provided below:

American National Standards (ANSI)[3]

X3.1—1969 Signalling Speeds for Data Transmission.

X3.4—1968 American Standard Code for Information Interchange.[4]

X3.15—1966 Bit sequencing of the U.S.A. Standard Code for Information Interchange in Serial-by-Bit Data Transmission.[5]

X3.16—1966 Character Structure and Character Party Sense in Serial-by-Bit Data Communication in the U.S.A. Standard Code for Information Interchange.[5]

X3.24—1968 Signal Quality at Interface between Data Processing Terminal Equipment and Synchronous Data Communication Equipment for Serial Data Transmission (EIA RS-334).

X3.25—1968 Character Structure and Character Parity Sense for Parallel-by-Bit Data Communication in the U.S.A. Standard Code for Information Interchange.[5]

X3.28—1971 Procedures for the use of the Communication Control Characters of the U.S.A. Standard Code for Information Interchange in Specified Data Communication Links (currently being processed).

Electronic Industry Association Standards (EIA)[6]

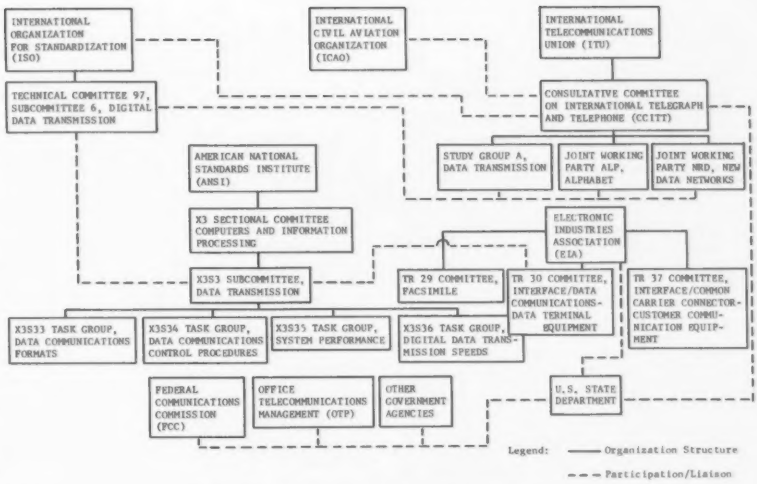
RS232C Interface between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange.

RS334 Signal Quality at Interface between Data Terminal Equipment and Synchronous Data Communication Equipment for Serial Data Transmission.

RS366 Interface between Data Terminal Equipment and Automatic Calling Equipment for Data Communication.

International Recommendations (ISO)[3]

R1177 Character Structure for Start/Stop and Synchronous Transmission.


INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)
INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO)
INTERNATIONAL TELECOMMUNICATIONS UNION (ITU)
TECHNICAL COMMITTEE 97, SUBCOMMITTEE 6, DIGITAL DATA TRANSMISSION
CONSULTATIVE COMMITTEE ON INTERNATIONAL TELEGRAPH AND TELEPHONE (CCITT)
AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
STUDY GROUP A, DATA TRANSMISSION
JOINT WORKING PARTY ALP, ALPHABET
JOINT WORKING PARTY NRD, NEW DATA NETWORKS
X3 SECTIONAL COMMITTEE COMPUTERS AND INFORMATION PROCESSING
ELECTRONIC INDUSTRIES ASSOCIATION (EIA)
X3S3 SUBCOMMITTEE, DATA TRANSMISSION
TR 29 COMMITTEE, FACSIMILE
TR 30 COMMITTEE, INTERFACE/DATA COMMUNICATIONS-DATA TERMINAL EQUIPMENT
TR 37 COMMITTEE, INTERFACE/COMMON CARRIER CONNECTOR-CUSTOMER COMMUNICATION EQUIPMENT
X3S33 TASK GROUP, DATA COMMUNICATIONS FORMATS
X3S34 TASK GROUP, DATA COMMUNICATIONS CONTROL PROCEDURES
X3S35 TASK GROUP, SYSTEM PERFORMANCE
X3S36 TASK GROUP, DIGITAL DATA TRANSMISSION SPEEDS
FEDERAL COMMUNICATIONS COMMISSION (FCC)
OFFICE TELECOMMUNICATIONS MANAGEMENT (OTP)
OTHER GOVERNMENT AGENCIES
U.S. STATE DEPARTMENT
Legend: Organization Structure
Participation/Liaison

Data Communication Standard Organizations

DR1732 Use of Longitudinal Parity to Detect Errors in Information Messages.

DR1745 Basic Mode Control Procedures for Data Communication Systems.

DR2110 Assignment of Connector Pins.

DR2111 Code Independent Transmission Procedures.

International Recommendations (CCITT)[7]

V.1 Equivalence between binary notation symbols and the significant conditions of a two-condition code.

V.2 Power levels for data transmission over telephone lines.

V.3 International alphabet number 5 for transmission of data and messages.

V.4 General structure of signals of the 7 unit code for data and messages transmission.

V.10 Use of the telex network for data transmission at the modulation rate of 50 bauds.

V.11 Automatic calling and/or answering on the telex network.

V.13 Answer-back unit simulators.

V.21 200-baud modem standardized for use in the general switched telephone network.

V.22 Standardization of modulation rates and data-signalling rates for synchronous data transmission in the general switched telephone network.

V.23 600/1200-baud modem standardized for use in the general switched telephone networks.

V.24 Functions and electrical characteristics of circuits at the interface between data terminal equipment and data communication equipment.

V.25 Automatic calling and/or answering on the general switched telephone network.

V.26 2400 bits per second modem for use on four-wire leased point-to-point circuits.

V.30 Parallel data transmission systems for universal use on the general switched telephone network.

V.35 Transmission of 48 kilobits per second data using 60 to 108 kHz group bank circuits.

V.40 Error indication with electro-mechanical equipment.

V.41 Code-independent error control system.

V.50 Standard limits for transmission quality of data transmission.

V.51 Organization of the maintenance of international telephone-type circuits used for data transmission.

V.52 Characteristics of distortion and error rate measuring apparatus for data transmission.

V.53 Limits for the maintenance of telephone-type circuits used for data transmission.

[1] The term "telecommunications" refers to the transmission of information in either digital or analog form employing electrical or electromagnetic media. Data communications refers to the transmission of digitized information or data using telecommunication facilities between data terminal and/or computers.

[2] Previous issues of the Federal Information Processing Standards (FIPS) notes, dated February and May 1970, have described the international (ISO) and national (ANSI) organizations established for information processing standardization.

[3] Available from American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

[4] Approved as FIPS 1.

[5] Recommended FIPS.

[6] Available from Electronic Industries Association, 2001 Eye Street NW., Washington, D.C 20006.

[7] Available from International Telecommunications Union, Place des Nations 1211, Geneva 20, Switzerland.

NATIONAL STANDARD NSRDS REFERENCE DATA SYSTEM NEWS

The NSRDS was established to make critically evaluated data in the physical sciences available to science and technology on a national basis. The NSRDS is administered and coordinated by the NBS Office of Standard Reference Data.

CRYOGENIC DATA CENTER

The Cryogenic Data Center (CDC) of the Bureau's Boulder Laboratories is the major U.S. source of bibliographic information and data on the cryogenic (low-temperature) properties of solids, liquids, and gases. Its primary mission is to compile and critically evaluate data on cryogenic properties and measurements.

As a result of its comprehensive examination and storage of published material in the field of cryogenics, the CDC is able to offer several bibliographic services to the public: Weekly and quarterly reference lists of published papers, custom literature searches on any topic in cryogenics, and consultative information services.

The particular value of the CDC's services stems from the nature of the staff: the compilers, evaluators, and literature search personnel are professionals in the field of cryogenics. The extensive indexing and cross-referencing of each paper and article included in the storage files is done by these professionals to ensure that all pertinent titles and data are retrieved on request. The files contain over 65,000 documents at present, with about 7500 added each year.

The principal output of the CDC is critically evaluated data, taken mainly from published sources. The raw data are obtained from a comprehensive review and examination of hundreds of journal articles and reports. Each property measurement is analyzed for its validity and probable accuracy and precision before being compiled into a table or chart of evaluated data. These critical evaluations and compilations then may become part of the National Standard Reference Data System. Examples of the sort of data dealt with by the Evaluation and Compilation Unit are: thermodynamic and transport properties of fluids and fluid mixtures; electrical, magnetic, optical, and surface properties of pure fluids; and thermal, electrical, and transport properties of elemental metals, dielectrics, and selected alloys. Two recent publications of critically evaluated data are NBS Monograph 94, *Thermodynamic and Related Properties of Parahydrogen from the Triple Point to 100 °K at Pressures to 340 Atmospheres*[1] (75 cents, SD Catalog No. C13.44:94) by H. M. Roder, L. A. Weber, and R. D. Goodwin, and NSRDS–NBS 27, *Thermodynamic Properties of Argon from the Triple Point to 300 K at Pressures to 1000 Atmospheres*,[1] ($1.25, SD Catalog No. C13.48:27), by A. L. Gosman, R. D. McCarty, and J. G. Hust.

The huge mass of data needed as raw materials for the evaluation process is acquired by the Documentation Unit. Information on cryogenic properties is widely scattered throughout the technical literature, and the Documentation Unit's cryogenic specialists constantly scan more than 300 journals in search of this information. In addition to this cover-to-cover examination of current literature, there is close scrutiny of three title-announcement periodicals and twenty abstracting services.

In this way, more than 325 000 papers, titles, and abstracts were examined in 1969. Copies of those items containing data on the properties of interest are then obtained from the journal or author. The papers are stored on microfilm or microfiche, or occasionally in full size.

Each paper selected for storage is indexed on master catalog cards. Codes are assigned to indicate language, type of article, form of data, temperature range, types of properties and other subject information. The philosophy has been to use a rather simple indexing system and highly skilled, knowledgeable indexers, instead of a highly structured indexing language and relatively unskilled indexers. The quality of the output is a direct result of the high quality of the indexing.

All the information about the paper, including author, references and subject indexing, is then entered on punched cards and stored on magnetic tape. Programs have been written to retrieve references according to subject, author, or other index terms, permitting searches to be made on narrowly defined subjects.

The CDC can thus supply custom bibliographies on any specific topic in cryogenics. Each output list is carefully reviewed by a member of the professional staff to insure that it adequately covers the customer's request. The cost of a search is based on the

Hans Roder (left), leader of the Data Compilation Group, discusses some requirements for themodynamic charts with Victor Johnson (center), Chief of the Cryogenic Data Center, and Neil Olien, leader of the Documentation Group.

professional and computer time used, and may vary from $30 for a simple search to several hundred dollars for a comprehensive list of all publications dealing with the properties of, say, helium.

The system has been designed for versatility, so that it isn't limited to the straightforward tasks mentioned above. For example, requests were filled for information on the growth of research in transport properties of fluids as compared to the rest of cryogenics, and on the growth of superconductivity research. Another complex request was for a list of all laboratories in Western Europe involved in superconductivity research.

Besides the critical evaluation of data and the custom bibliographies, the large amount of information scanned on a current basis permits the distribution of complete listings of current published literature in cryogenics. These listings give up-to-date notice of articles, papers, patents, and reports for cryogenics as a whole, and for the subcategories of superconductivity and liquefied natural gas.

The oldest of the three listings is the Current Awareness Service (CAS), printed weekly since 1964. It lists all articles and papers on cryogenics encountered by the staff during their scan of journals, title announcements, and patents. More than 8900 publications were listed in the CAS in 1969, giving the date, page, volume, title and author of each article.

The other two periodicals published by the Data Center appear every 3 months, providing the same type of information as the CAS, but limited to the subjects of Superconducting Devices and Materials, and Liquefied Natural Gas. The SD&M Quarterly is produced in cooperation with the Office of Naval Research, and usually includes some 100 to 200 titles per issue. The LNG Quarterly, begun in 1970 in cooperation with the American Gas Association, is about the same size.

The subscription price of each of the three series is $15 per year in North America, or $20 to the rest of the world by airmail. Checks, made payable to NBS, Department of Commerce, should be mailed to the Cryogenics Data Center, Room 2022 Cryogenics Building, NBS, Boulder, Colo. 80302. Foreign subscribers can use UNESCO coupons, or checks made out to any U.S. bank.

TABLES OF ATOMIC SPECTRA

The recent publication of NSRDS–NBS 3, section 3, *Selected Tables of Atomic Spectra, Atomic Energy Levels and Multiplet Tables, C I, C II, C III, C IV, C V, C VI,*[1] ($1, SD Catalog No. C13.48:3/Sec. 3) by Charlotte E. Moore is the third and latest Section of a series that is being prepared in response to the increasing demand for a current revision of two sets of tables, by the same author, containing data on atomic spectra as derived from analysis of optical spectra. These data were originally presented in two sets of tables, both by Charlotte E. Moore. *Atomic Energy Levels*, NBS Circular 467, consisted of three volumes published in 1949, 1952, and 1958, while *An Ultraviolet Multiplet Table*, NBS Circular 488, was published from 1950 to 1962. In the present Section, Part A contains the atomic energy levels and Part B the multiplet tables. All six spectra of carbon, C I through C VI, are included. The earlier NSRDS–NBS 3, Section 1 (35 cents)[1] includes three spectra of silicon, Si II, Si III, Si IV; NSRDS–NBS 3, Section 2 (20 cents)[1] covered similar data for Si I.

CHEMICAL KINETICS SURVEY

The Committee on Data for Science and Technology (CODATA) of the International Council of Scientific Unions, has established a Task Group on Data for Chemical Kinetics. The Group is chaired by Dr. Sidney W. Benson, Stanford Research Institute. One of the tasks singled out by the Group for immediate implementation is the identification of work now in being (or planned) involving the compilation and evaluation of rate data for each of the member States. Dr. T. N. Newton, Los Alamos Scientific Laboratories, has been designated to carry out this task in the United States. The Office of Standard Reference Data is helping with the gathering of this information.

For the purposes of this survey, chemical kinetics has been broadly defined. It includes rates and mechanisms of chemical reactions in all

phases, energy and charge transfer processes, etc. The Task Group is concerned with data compilations and evaluations of rates, cross sections and quantum yields, both published or unpublished, be they single reaction or a set of reactions; it is not attempting to record experimental programs in chemical kinetics.

A survey has been sent to chemists working in chemical kinetics, molecular dynamics and related kinetic areas. The Task Group is seeking to reach all workers in the field. Anyone who is conducting such work should contact the Task Group by writing to Dr. L. H. Gavantman, Office of Standard Reference Data, National Bureau of Standards, Washington, D.C. 20234.

NN AND ND INTERACTIONS

NSRDS–UCRL–20000NN, *NN and ND Interactions (above 0.5 GeV/c)—A Compilation*, August 1970, by Odette Benary, LeRoy R. Price, and Gideon Alexander, is the third publication by the Berkeley Particle Data Center, Lawrence Radiation Laboratory, within its NSRDS series of publications. This compilation covers pp, np, nn, pd, and np interactions in the range of beam moment from 0.5 to 70 GeV/c. The cutoff date of the 165 papers covered is July 1970. Included in this publication are a complete listing of the selected data, a momentum index, a keyword index and a reference list. Copies of NSRDS–UCRI–20000NN, August 1970 as well as the earlier two compilations may be obtained by request to the Berkeley Particle Data Center, Lawrence Radiation Laboratory, Berkeley, Calif. 94720.

STANDARDS AND CALIBRATION

STANDARD FREQUENCY AND TIME BROADCASTS

High-frequency radio stations WWV (Fort Collins, Colo.) and WWVH (Maui, Hawaii) broadcast time signals on the Coordinated Universal Time (UTC) system as coordinated by the Bureau International de l'Heure (BIH), Paris, France. The NBS time scale, UTC (NBS), and the U.S. Naval Observatory time scale, UTC(USNO), are jointly coordinated to within ± 5 microseconds. The UTC pulses occur at intervals that are longer than one coordinate second by 300 parts in 10^{10} during 1971, due to an offset in carrier frequency coordinated by BIH. To maintain the UTC scales in close agreement with the astronomers' time, UT2, phase adjustments are made at 0000 hours Greenwich Mean Time (GMT) on the first day of a month as announced by BIH. *There will be no adjustment made on May 1, 1971.*

The low-frequency radio station WWVB (Fort Collins, Colo.) broadcasts seconds pulses without offset to make available to users the standard of frequency so that absolute frequency comparisons may be made directly, following the Stepped Atomic Time (SAT) system. Step time adjustments of 200 ms are made at 0000 hours GMT on the first day of a month when necessary. BIH announces when such adjustments should be made in the scale to maintain the seconds pulses within about 100 ms of UT2. *There will be no adjustment made on May 1, 1971.*

NBS obtains daily UT2 information from forecasts of extrapolated UT2 clock readings provided by the U.S. Naval Observatory with whom NBS maintains close cooperation.

WWV & WWVH TO CHANGE PROGRAM FORMAT

Standard time and frequency radio stations WWV and WWVH plan to revise the formats of their broadcasts, beginning at 0000 hours UT (Universal Time, or Greenwich Mean Time) on July 1, 1971. The most important features of the new format will be voice announcements of the time every minute instead of every 5 minutes, use of male and female voices to help distinguish between WWV and WWVH, and elimination of all Morse code signals from the transmissions. Only the content of the broadcasts will change; the carrier frequencies will remain the same.

The formats of WWV (transmitted from Colorado) and WWVH (transmitted from Hawaii) will be similar, but confusion between them will be avoided by using alternate time slots for the transmission of tones, announcements, etc. Both stations will broadcast standard tones and a "tick" every second as in the past. These stations are operated by the NBS Boulder Laboratories, and their signals are controlled by the NBS Atomic Frequency Standard.

Each hour will be divided into 1-minute slots; each minute (except the first) will begin with an 0.8-second tone of 1000 Hz at WWV or 1200 Hz at WWVH. The first minute in each hour will begin with an 0.8-second tone of 1500 Hz at both stations. The minute slots will be divided into a 45-second segment and two 7.5-second segments: on alternate minutes the 45-second segment will contain either a standard tone (tentatively 600 Hz) or an announcement.

The announcement slots will be available to Government agencies for

their own purposes. Arrangements for Federal agency use of the 23 or 24 available time slots at each station may be made by contacting the Time and Frequency Division, National Bureau of Standards, Boulder, Colo. 80302. Those announcements slots not used by NBS or other agencies will be filled by another standard tone, probably 500 Hz. To prevent interference in those parts of the world which receive both WWV and WWVH, one station's announcements will be scheduled to coincide with the other's tones, and vice versa.

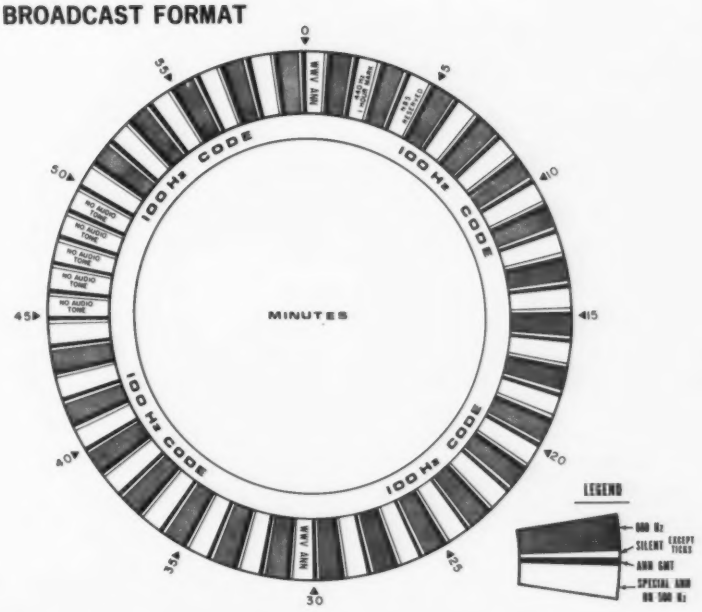
The first 7.5-second segment following the 45-second period will be used by WWVH to announce the time, while WWV is silent. The second 7.5-second segment will be used by WWV to announce the time, while WWVH is silent. WWVH will use a feminine voice, and WWV a masculine.

In the broadcasts of each station, several of the announcement slots will be reserved for NBS use and station identification. Also, each station will omit for 5 minutes of each hour all tones and announcements during the 45-second segments; this period will begin at 45 minutes past the hour at WWV, and 15 minutes past the hour at WWVH.

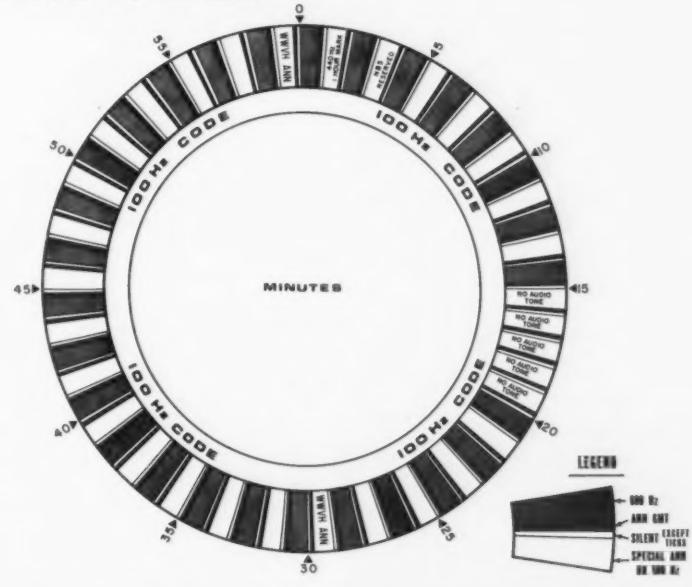
A special 440-Hz tone will be broadcast for 45 seconds beginning 1 minute (WWVH) or 2 minutes (WWV) after the hour. This tone may be used to mark the hours on a strip-chart recorded. The tone is omitted during the zero hour of each UT day.

At all times, during announcements and tones, there will be the usual 1-second markers or "ticks", except the 29th and 59th marker in each minute will be omitted. The 60th marker, which begins the minute, will be lengthened to 0.8 second. All other markers will consist of a 5-millisecond pulse of 1000 Hz (1200 Hz at WWVH) beginning at the beginning of the second. Each pulse will be preceded by 10 ms of silence and followed by 25 ms of silence. These "windows"—40-ms long—will not appreciably degrade the intelligibility of announcements.

WWV BROADCAST FORMAT



WWVH BROADCAST FORMAT



The time and frequency signals broadcast by WWV may be heard now by telephone. Call (303) 447–1192 to hear the broadcast as received by radio in Boulder. Given the instability of propagation both in the air and in the telephone system, the listener should not expect the accuracy of the time signals to be better than 10 ms (0.01 second). This service will continue as long as the demand for it exists.

SUPERCONDUCTING DEVICE MEASURES HEARTBEAT MAGNETICALLY

MEASURING HEARTBEAT WITHOUT DIRECT ELECTRICAL or physical connections to the body has been achieved by the Cryogenics Division, in Boulder, Colo. Developed by J. E. Zimmerman and N. V. Frederick, the instrument, known as a magnetocardiograph, generates electrical signals that are proportional to the heart's magnetic pulses when it is placed in close proximity to the heart. When used to drive an oscilloscope or a strip-chart recorder, these signals provide a magnetocardiogram (MKG) of the heartbeat similar to an electrocardiogram (EKG).

By comparison, an MKG requires no electrodes to be attached to the patient's chest and therefore does not require disrobing. An MKG is also faster and more convenient than other methods. However, it does pose problems. For example, the earth's magnetic field must be compensated for and measurements must be made in a magnetically "quiet" environment away from extraneous fields generated by motors, power lines, laboratory equipment, etc. Successful experiments have been carried out in an abandoned mine shaft in the mountains west of Boulder.

Technically, the device is a superconducting gradiometer which measures the difference of the magnetic field existing between two superconducting coils connected in series opposition. The opposing connection cancels the effect of fluctuations ($\approx 10^{-10}$T) in the earth's magnetic field ($\approx 0.5 \times 10^{-4}$T). By positioning the device so that one of the coils is close to the patient's heart, magnetic heartbeat pulses can be detected.

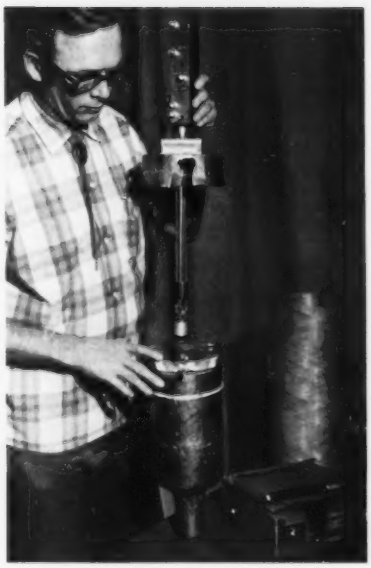
A vital element of the instrument is a superconducting quantum-mechanical interference device, known as the SQUID and consisting of a block of niobium having two parallel holes (3-mm dia.) joined by a slot coplanar with the holes. The slot is bridged at one point by a point-contact Josephson junction.

The Josephson junction, a recently discovered device, uniquely allows magnetic flux to shift back and forth between the two parallel holes in discrete units (flux quanta). Flux is coupled into the SQUID via a flux transformer consisting of the two external superconducting and opposing coils connected in series with a small superconducting coil placed inside one of the holes in the SQUID. Another nonsuperconducting coil placed in the other hole is resonant at an rf frequency. The rf impedance of this second coil varies periodically with the flux distribution between holes; one period corresponds to a complete flux quantum. By detecting the change in rf impedance, the difference in the magnetic field impinging on the two external coils can be measured.

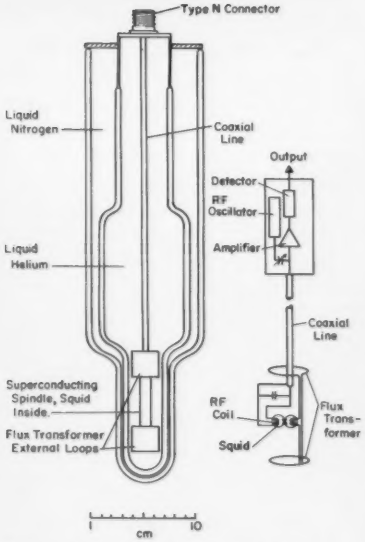
In addition to biomedical applications, the superconducting sensor is useful for detecting magnetic anomalies in the earth's magnetic field distribution. Detection range depends on the strength of the anomaly, noise and gradient fluctuations of the ambient field. Submarine detection is one such possible application. Other areas of interest are geophysical exploration and paleomagnetism.

Typical magnetocardiogram made in a relatively quiet rural environment.

Left: Nolan Frederick demonstrates how the superconducting magnetogradiometer would be positioned to measure heartbeat pulses over a reclining patient. Magnetocardiograms could be taken from a sitting position as well. Equipment shown is a prototype version very susceptible to minute fields from power lines and other magnetic noise. Until a method of cancelling such noise is developed, measurements must be made in a shielded or magnetically quiet environment.

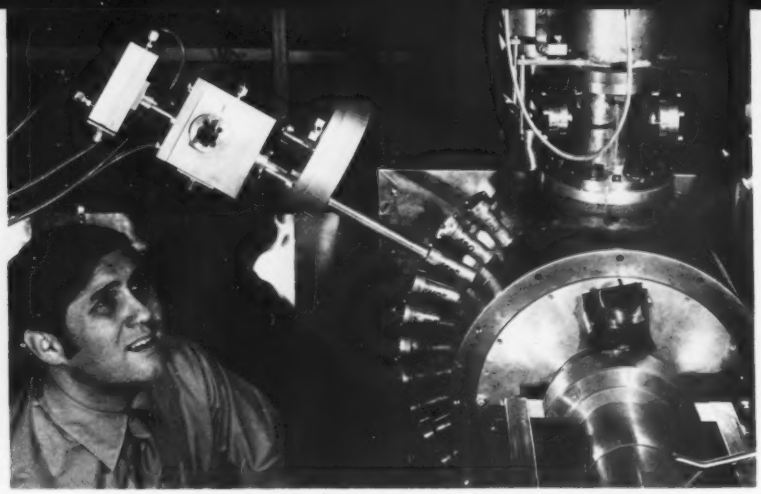


Laboratory version of ultrasensitive superconducting magnetic gradiometer for use in cardiography and other applications.

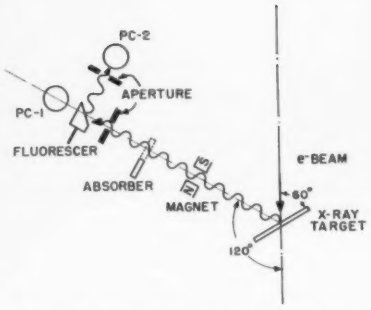


Schematic diagram of cryostat and flux transformer. External coils of the flux transformer are made of a single turn of a wide band of sheet niobium. The rf coil inside the SQUID is a nonsuperconducting multi-turn copper coil. The entire assembly is immersed in a dewar filled with liquid helium (4K) surrounded by an outer dewar filled with liquid nitrogen.

Adjusting the point contact of a SQUID (Superconducting Quantum-mechanical Interference Device).
Plots of error of the force indication against speed with which force is applied by a universal testing machine. The greater the speed, the greater the error of the machine's instantaneous indication of force.



Charles E. Dick inspects apparatus (left, above his head) for measuring the K-shell fluorescence yields of five light elements. The apparatus employs high intensity K x rays produced in the target chamber (right) of the 500 keV constant-potential, electron accelerator.



Schematic diagram of apparatus used in determining the K-shell fluorescence yields of light elements.

FLUORESCENCE YIELDS MEASURED FOR LIGHT ELEMENTS

A CHARACTERISTIC PROPERTY OF ATOMS, known as the K-shell fluorescence yield, has been determined for several light elements, some for the first time. Charles E. Dick and Arthur C. Lucas of the Applied Radiation Division measured the K-shell fluorescence yields of beryllium, boron, carbon, fluorine, and magnesium,[1] using a 500 keV constant-potential electron accelerator and a vacuum apparatus under advanced development for producing high-intensity, K x-ray beams.

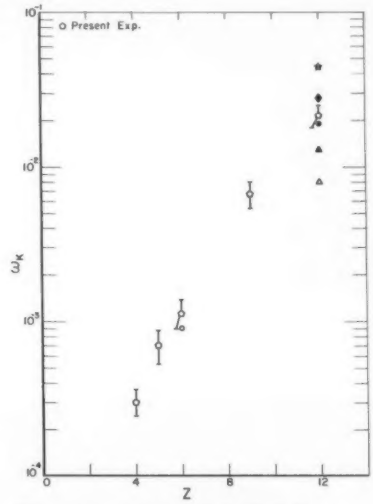
When an ionized atom reverts to the ground state, it may emit either an x ray or an Auger electron. The fluorescence yield for any particular atomic shell is defined as the probability that an excited atom will emit a characteristic x ray in the first transition, rather than an Auger electron. This characteristic property is used in the determination of elemental cross sections, in stopping power theory, nuclear decay schemes, and in predicting the emission rate of x-ray sources.

These measurements have been particularly difficult for several reasons. The very light elements emit very low energy x rays, requiring very sensitive detection apparatus. There must be practically no absorption of the emitted x rays, necessitating a vacuum system and very thin detector windows. In addition, for the light elements, the deexcitation process is dominated by Auger electron emission. Therefore, large numbers of ionized atoms must be produced, which requires an intense excitation source.

MEASUREMENT

The K-shell fluorescence yield was measured for the first time for beryllium, boron, and fluorine. The second measurement was made for carbon (the first measurement was made over 30 years ago), and the sixth measurement was made for magnesium (this measurement appears as the probable average of the five previous measurements).

The experimental procedure was to irradiate the element of interest with a high-intensity, K, x-ray beam. X rays absorbed by a K-shell electron result in the ejection of the electron from the atom. Fluorescent x-ray emission emitted in the subsequent deionization was detected by a proportional counter placed at 90° to the incident beam. Background measurements were made by placing absorber materials in the path of the incident x rays and then observing the fluorescence yields.



The pentagons represent the K-shell fluorescence yield, ω_k, plotted versus the atomic number, Z, for the five light elements measured at NBS. Additional points represent previous similar measurements of fluorescence yields.

[1] Dick, C. E., and Lucas, A. C., K-shell fluorescence yields for light elements, Phys. Rev. A 2, No. 3, 580–586 (Sept. 1970).

UNIVERSAL TESTING MACHINE ERRORS MEASURED

DYNAMIC ERRORS IN FORCE INDICATIONS OF universal testing machines—devices applying force for testing materials—have recently been quantified at the NBS Institute for Basic Standards. These errors can be measured by a test method proposed by the American Society for Testing and Materials (ASTM). NBS engineer Donald C. Robinson measured the dynamic errors for three machines used at the Institute's engineering mechanics laboratories, using a modification of the ASTM method offering improved resolution. His data, the first published quantification of this error, supports the supposition that the error is a function of speed of testing.[1]

UNIVERSAL TESTING MACHINES

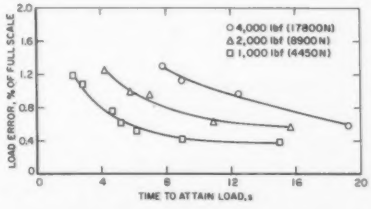
Universal testing machines are machines for applying controlled forces in tests of materials. The force is typically applied by mechanical or hydraulic means and is measured by an indicator that is built into the testing machine. The machine can be calibrated by comparison with a reference standard loaded in the machine. Typical types of these standards are load cells and proving rings; NBS offers a calibration service for such devices.

The ASTM recognized that indication errors occur when dynamic forces are applied by universal testing machines and has proposed a method of determining these errors.[2] The procedure uses a digital voltmeter to measure the output of a load cell and a motion picture camera to record simultaneous indications of the voltmeter and of the machine's indicator.

Engineer Donald Robinson prepares to trigger still camera to record readings of universal test machine force indicator, clock, and digital voltmeter. The voltage indicates the force on the load cell. Mr. Robinson found that the machine's instantaneous force indication lags changes in applied force.

ERROR ANALYSIS

Mr. Robinson used a modified version of the method proposed by the ASTM to determine the errors of three universal testing machines at the NBS engineering mechanics laboratory. A high-speed film in a 4- × 5-inch still camera was used to record simultaneous readings of the machine indicator, the digital voltmeter, and a clock. This photographic equipment made possible greater measurement resolution without special lighting equipment, thereby eliminating glare in the photographs.



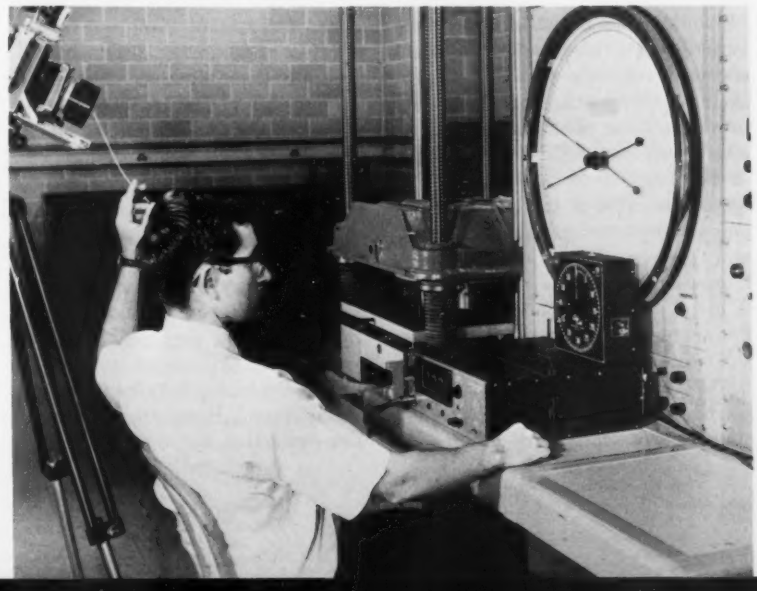
Plots of error of the force indication against speed with which force is applied by a universal testing machine. The greater the speed, the greater the error of the machine's instantaneous indication of force.

The NBS universal testing machines evaluated are of three different capacities and types. One is a 10 000-lbf (44.5-kN) capacity machine operated by mechanically driven screws and indicating via the output of strain-gage load cells in the weighing system. The second is a 60 000-lbf (267-kN) machine having a fixed upper platen and hydraulically positioned lower platen. The load is indicated by Bourdon-tube indicators connected to hydraulic load cells in the machine. The third machine is of 400 000-lbf (1780-kN) capacity, the mechanically driven loading of which is transmitted by torque bars to a weighing system. The torque bar deflections are sensed by differential transformers.

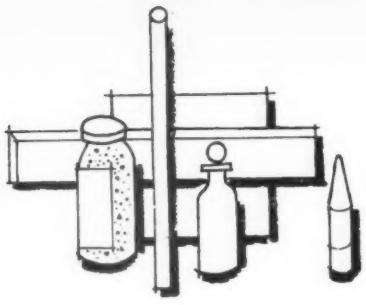
The data obtained for several rates of loading contained errors resulting from the lag of the built-in force indicator; these were linearly related to the loading rate or to the rate-of-motion of the indicator pointer, in each case. This Bureau study shows that assuming dynamic measurements of loads at nominal testing speeds to be correct may lead to significant errors. The extent of the errors can be found by tests, such as described.

[1] Robinson, Donald C., Determination of load errors in universal testing machines due to speed of testing, ASTM Matl. Res. & Stands. 11 No. 1, 14–17 (Jan. 1971).

[2] The above reference contains as an appendix ASTM's "Proposed Method of Determining Errors in Tension Testing Machines due to Speed of Testing."



STANDARD REFERENCE MATERIALS



TWELVE NEW STANDARDS

THE OFFICE OF STANDARD REFERENCE MATERIALS has recently made available 12 new Standard Reference Materials (SRM's).[1] The new standards are: SRM 485, Austenite in Ferrite; SRM 493, Iron Carbide in Ferrite; SRM 720, Synthetic Sapphire; SRM 723, tris(Hydroxymethyl)-aminomethane (2-Amino-2-Hydroxymethyl-1,3-propanediol); SRM 917, D-Glucose; SRM's 1206–2, 1207–1, 1207–2, 1208–1, and 1208–2, High Temperature Alloys; and two microanalysis standards—SRM 2141, Urea, and SRM 2142, *o*-Bromobenzoic Acid.

AUSTENITE IN FERRITE

Increasing demands for heat treated steels containing low and accurately known amounts of retained austenite have, in turn, created a need for a standard reference material to calibrate x-ray diffraction equipment used in determining the quantity of retained austenite. SRM 485, Austenite in Ferrite, is intended to meet this need. The SRM is in disk form, 21 mm in diameter and 2.5 mm thick, and contains 4 percent austenite, nominally. The actual certified value is given on a label on each disk (to the nearest 0.1 percent), and is considered accurate to ± 0.2 percent. SRM 485 costs $85 per disk.[2]

SKC/PM Engineering produced the standards. Extensive evaluation tests conducted at NBS included metallographic and x-ray diffraction examinations as well as analyses by electron microprobe and x-ray fluorescence methods. (A 15 percent austenite in ferrite SRM is in the production stage and should be available in mid-1971.)

IRON CARBIDE IN FERRITE

SRM 493, Spheroidized Iron Carbide (Fe_3C) in Ferrite, is primarily for use in calibrating x-ray diffraction equipment. This SRM is in wafer form, 29 mm square and 2.5 mm thick. The average iron carbide concentration in any wafer is 14.23 ± 0.30 percent by volume (95 percent confidence limits). SRM 493 costs $85 per wafer.[2]

The determination of iron carbide is often important in itself, and the accurate determination of retained austenite may depend in part upon the capability to analyze for iron carbide. SRM 493, when used in conjunction with SRM 485, Austenite in Ferrite, will allow calibration of equipment so that determinations of the relative amounts of two of the most important microstructural constituents in steel can be made.

The material for SRM 493 was processed at NBS from an alloy of carbon and high-purity iron produced at the Naval Research Laboratory. The evaluation for certification performed at NBS consisted of extensive measurements by two quantitative optical methods together with accurate carbon determinations.

SAPPHIRE

SRM 720, Synthetic Sapphire (Al_2O_3), has been issued as a standard reference material for calorimetry. The enthalpy and heat capacity of 99.95+ percent α-alumina are certified over the temperature range 273.15 to 2250 K. SRM 720 costs $56 for a 15-gram unit.[2]

Although NBS has been engaged in the measurement of heat capacity and enthalpy for many years, this is the first SRM in this area. In the past, samples of n-heptane, benzoic acid and alumina issued by the Calorimetry Conference, Inc., have served to standardize heat-capacity calorimetric measurements. SRM 720 is another step forward in this important area.

The data certified are smoothed values for enthalpy and heat capacity derived from enthalpy measurements on the sapphire. The experimental values were determined by the drop method using a Bunsen-type ice calorimeter at temperatures from 273.15 to 1173.15 K and a high-temperature drop method from 1173.15 to 2250 K. All temperatures are expressed in terms of the IPTS–68 scale. The enthalpy values are believed to be accurate to ± 0.1 percent at tempera-

tures below 1173 K and to ±0.2 percent above this temperature.

TRIS(HYDROXYMETHYL)AMINOMETHANE

SRM 723, 2-amino-2-hydroxymethyl-1,3-propanediol, more commonly known as *tris* (Hydroxymethyl) aminomethane, is the first basimetric SRM issued by NBS. SRM 723 costs $50.75 for a 50-gram unit.[2]

Four of the fundamental processes used in analytical chemistry are acidimetry, basimetry, oxidation, and reduction. For many years the NBS Standard Reference Material program has issued SRM's for acidimetry (acid potassium phthalate, 84h; benzoic acid, 350), oxidimetry (potassium dichromate, 136c) and reductimetry (sodium oxalate, 40h; arsenic trioxide, 83c). The use of this new basimetric SRM allows the direct calibration of standard acids, obviating the necessity for the stepwise procedure whereby an acid is standardized against a base, which was previously standardized against one of the acidimetric SRMs.

The assay of the basimetric value of this SRM was made by a coulometric titration technique. The value certified is 99.9690±0.0030 weight percent. The uncertainty represents the 95 percent confidence interval of the mean for 30 determinations. The corresponding standard deviation of a single measurement is 0.0081 units.

D-GLUCOSE

SRM 917, D-glucose, certified for use as an analytical standard in clinical chemistry, costs $43 for a 25-gram unit.[2]

For many years, NBS has issued D-glucose (identified as Dextrose, SRM 41a) as a reductometric standard reference material. For this use it was not necessary that the SRM be well characterized with respect to trace metals. The new SRM 917 is intended for use with clinical procedures, many of which involve enzymatic reactions. Therefore, the new SRM is much more highly characterized than 41a. The metallic impurities in the ash are very low in concentration. The values for these impurities are given for the users' information, although they are not certified. The certified purity value has been evaluated by several means, and the relative amounts of α- and β-D-glucopyranose have been determined.

The determination of D-glucose in both serum and urine are among the more frequent analyses made in a clinical laboratory. Such determinations are generally used in the diagnosis of diabetes and in following the course of its treatment. They are also useful in the diagnosis of central nervous system diseases. The new D-glucose standard reference material makes available a central source of standard material to which D-glucose determinations made at different times and in different laboratories can be related and thereby made intercomparable.

HIGH TEMPERATURE ALLOYS

Five SRM's for three important high-temperature alloys have been certified. One is for René 41 (1206–2), while two each are for the Waspaloy (1207–1 and 1207–2) and Inco 718 (1208–1 and 1208–2). Issued in the form of solid sections approximately 31 mm square and 19 mm thick, the standards are designed primarily for application in x-ray spectrometric methods of analysis; however, they also may be useful in optical emission spectrometric methods of analysis. The SRM's cost $50 per unit, or may be purchased as a complete set (as SRM 1209) for $185 per set.[2]

High-temperature alloys are of vital importance to engineering applications that require high strength at elevated temperatures, especially in defense and space efforts. The standards have been certified for the important alloy elements nickel, chromium, molybdenum, titanium, aluminum, cobalt, niobium, and iron; other elements certified include carbon, manganese, phosphorus, sulfur, silicon, and copper.

The material for these standards was melted and cast at the American Cast Iron Pipe Co., Birmingham, Ala., with use of the NBS chill-cast mold assembly. Homogeneity testing and analyses for provisional certification were performed in the NBS Analytical Chemistry Division. Cooperative analyses for certification were performed in the analytical laboratories of Cameron Iron Works, Houston, Tex.; Carpenter Technology Corp., Reading, Pa.; Ladish Co., Cudahy, Wis.; and Cyclops Corp., Universal-Cyclops Specialty Steel Division, Bridgeville, Pa.

MICRO-ANALYSIS STANDARDS

Micro-analysis standards are furnished as fine crystals of suitable homogeneity for use in conventional microchemical methods of analysis. The two new micro-analysis standards are SRM 2141, Urea, and SRM 2142, *o*-Bromobenzoic acid, which cost $33 each per 2-gram unit.[2]

Urea is a compound of relatively high nitrogen content, 46.63 percent, issued to supplement the other micro-nitrogen SRM's acetanilide (SRM 141b), which contains an open-chain nitrogen atom, and nicotinic acid (SRM 148), which contains a heterocyclic nitrogen atom. Both 141b and 148 have relatively low nitrogen contents of 10.36 and 11.38 percent, respectively.

One of the aims of the Office of Standard Reference Materials is to augment the microchemical SRM's to include all of the halogen elements. SRM 2142 is the first of these. While certified only for the weight percentage of bromine, this *o*-Bromobenzoic acid has been characterized for identity and purity by several organic and physical chemistry techniques.

[1] For a complete list of Standard Reference Materals available from NBS, see Catalog of Standard Reference Materials, NBS Special Publication 260 (July 1970 ed.) for sale by Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for 75 cents. Order by SD Catalog No. C13.10:260 (1970 ed.).

[2] These SRM's may be purchased for the prices indicated from the Office of Standard Reference Materials, Room B314, Chemistry Building, National Bureau of Standards, Washington, D.C. 20234.

NEW SULFUR DIOXIDE PERMEATION TUBE

Standard for Pollution-Measuring Devices

SULFUR DIOXIDE, RELEASED INTO THE atmosphere when sulfur-containing coal and fuel oil is burned, is believed to have been a cause of the London air pollution disaster of 1952 and of continued respiratory-related deaths in American cities. Now a new Standard Reference Material (SRM) issued by NBS makes possible the accurate determination of the sulfur dioxide content of the air, a key step in the fight against pollution. This SRM is based on original work done by scientists of the Air Pollution Control Office of the Environmental Protection Agency, which later supported development of the SRM by the NBS Office of Standard Reference Materials.

This SRM consists of a plastic tube filled with liquid sulfur dioxide, which permeates the walls of the tube and is emitted as a gas at a rate that is temperature dependent. Knowing this rate, which is certified by NBS, permits users of gaseous pollution-measuring equipment to calibrate their instruments with an accuracy and convenience not previously possible.

MEASURING POLLUTANT CONCENTRATION

Devices for measuring gaseous pollutants may be calibrated by passing through them a reference standard, a gas containing a known proportion of specific pollutants, typically obtained from cylinders of the compressed gas. This is not possible with sulfur dioxide because stability problems are encountered. To make known amounts of sulfur dioxide available A. E. O'Keeffe and G. C. Ortman of the National Air Pollution Control Administration (now the Air Pollution Control Office of the Environmental Protection Agency) developed a package for the liquid that consist of a plastic tube through which the gas permeates at a rate determined by the temperature. In an investigation sponsored by NAPCA the Bureau's scientists reported favorably on using the SO_2 tube as a reference standard for pollution-measuring instrumentation.

Ernest Hughes performs a gravimetric calibration of a sulfur dioxide permeation tube. These tubes are now issued as a Standard Reference Material for use in calibrating instruments for measuring air pollution.

Although such tubes are now available commercially, the user must rely on the manufacturer's lot calibration unless he calibrates the tube's permeation rate himself. The need for a calibrated tube has now been filled by issuing Standard Reference Material 1625, Sulfur Dioxide Permeation Tube, available at a cost of $50 per tube. The first tube issued was presented to Dr. John T. Middleton, Acting Commissioner of the Air Pollution Control Office, by Dr. Lewis M. Branscomb, NBS Director, on December 1.

Tubes distributed as SRMs are accompanied by a certificate of analysis that states the tube's permeation rate in micrograms of sulfur dioxide per minute for integral degrees from 20 to 30 °C. These data are obtained by Ernest Hughes and William Schmidt, of the staff of the Bureau's Institute for Materials Research, from gravimetric calibration of each tube at three temperatures and processing the rates found to a least-squares fit by computer to obtain the values listed on the certificate. Also given is a formula for calculation of permeation rates at intermediate temperatures.

Experiments show that the calibration remains valid as long as liquid sulfur dioxide can be seen in the tube. The useful life of a tube is about 9 months if maintained within the certified temperature range, and longer if stored at lower temperatures. This is a relatively rugged standard; the major precautions for its use are to prevent contamination of its outer surface and to protect it from high concentrations of water vapor.

The Bureau is actively engaged in a program, cosponsored with the Air Pollution Control Office, to provide other Standard Reference Materials for air pollution measurements and is active also in the general area of environmental analysis. SRMs planned and in preparation include: carbon monoxide, oxidants, and particulates. Two others, fuel oils with certified low sulfur content, are scheduled for early release (see table following).

Standard Reference Materials Related to Environmental Analysis

SRM 1601–1603 Carbon dioxide in nitrogen containing 308, 346, and 384 ppm CO_2, respectively.

SRM 1604–1608 Containing 3, 10, 112, 212, and 978 ppm oxygen in nitrogen, respectively.

SRM 1609 Air with oxygen content certified at atmospheric level.

SRM 1610–1613 Containing 1, 10, 100, and 1000 ppm methane in air, respectively.

SRM 1616–1620 Containing 10, 50, 100, 300, 500, and 1000 ppm CO in air, respectively. (available in near future)

SRM 1621, 1622 Residual fuel oils, containing 1.05 and 2.14% sulfur, respectively.

SRM 1800 Microstandard ion-exchange beads provide elemental standards at the microgram to nanogram level.

SRM 1625 Certified SO_2 Permeation Tubes

Magnetic Tape Cassette Program Initiated

A DIGITAL MAGNETIC TAPE CASSETTE PROGRAM will be undertaken by the Bureau, to support the voluntary standards development efforts underway within the American National Standards Institute (ANSI) Committee on Computer and Information Processing (X3). According to Dr. Ruth M. Davis, Director of the Bureau's Center for Computer Sciences and Technology, the NBS program will include the development and maintenance of a national amplitude reference tape for cassette applications, and the development of a related measurement system for evaluating the characteristics of digital cassette tapes. The initial efforts of the Center will be directed to the 150-mil-wide tape employed in the co-planar reel cassettes, currently the subject of standardization by ANSI. These cassettes are commonly referred to as "Phillips Type" cassettes.

The Center recognizes that the development and implementation of a "family" of technical standards and standards of measurement are essential in achieving compatibility and interchangeability of digital tape cassettes among the different data recording and reproducing equipments and to meet the increasing data capturing and storage needs of the user. The "Phillips Type" cassette is the first in this family of cassette standards, and various other types of digital tape cassettes, including higher performance cassettes with 250 mil (¼ inch) tape, are under consideration in the ANSI X3B1 Subcommittee. The application of mini computers that need equally compatible input/output storage media, and an increasing use of remote terminals will further expand the needs for this comparatively less expensive and higher performance storage media.

The principal purpose of the Center's efforts will be to provide the standards development activities, including the ANSI X3B1 Subcommittee, with a quantitative basis by which tape cassette characteristics can be meaningfully stated and evaluated for compatibility and interchangeability. The reference tapes will serve industry and Government as a yardstick for evaluating stated tape performance requirements, and for calibrating related tape testing equipment. The measurement system also will be used by NBS for producing and calibrating reference tapes and providing measurement services to users and producers of such tapes.

Additional Interlaboratory Programs for Rubber

AS A RESULT OF THE INTEREST revealed in a recent survey of rubber testing laboratories, three new interlaboratory programs have been established to facilitate the standardization of rubber testing among laboratories. NBS is offering the following new programs in 1971: tear strength, compression set and hardness, and Mooney viscosity, and will continue the current tensile strength, ultimate elongation, and tensile stress program.

For each program NBS distributes quarterly to the subscriber two standard ASTM sheets of each of two vulcanized rubbers, or for the viscosity program two portions of each of two rubbers. The subscriber will test the sheets or portions in accordance with the appropriate ASTM procedure, recording the values for each specimen and returning these values to NBS within 20 days. NBS will then analyze the data, prepare a report giving the original data and an analysis of the data of all the laboratories, and send the report to the subscriber before the next distribution of samples. In the report, and throughout the program, the subscriber will be identified only by code number, but NBS data will be identified. A summary report will be distributed at the end of the year, together with recommendations for modifications or additions to the program.

Briefly, the content and cost of the programs are as follows:

Tensile strength, ultimate elongation, and tensile stress. A continuation of the 1970 program, but the frequency of test has been reduced from bimonthly to quarterly. Four standard test sheets of vulcanized rubber will be distributed in January, April, July, and October 1971; specimens are tested from each sheet following ASTM D412. The cost of the program is $180.

Tear strength. The program uses Die C, ASTM D624 and tests will be made on vulcanized rubber sheets sent to the subscriber in February, May, August, and November 1971. The cost is $160.

Compression set and hardness. For compression set the program will use Method B, ASTM D395 and for hardness, ASTM D1415 or D2240. Of the two types of plied specimens used for compression set, one will be 6 plied disks 29 mm in diameter and the other, 3 plied disks 13 mm in diameter. Hardness is to be measured on the 29-mm plied disks prior to the

(*Continued p. 108*)

ACOUSTIC FORMULAS PREDICT PROPAGATION INSTABILITY

NBS Scientists Study Sound Transmission Equation

SCIENTISTS AT THE BUREAU have found that an unstable propagation can be predicted from equations describing transmission of sound in molten metals. The propagation is characterized by amplitudes that increase without bound with time. As no such phenomenon exists in reality, the explanation for the faulty prediction requires reexamination of previously unquestioned fundamental assumptions or experimental values. This finding, which will interest acousticians and thermodynamicists, resulted from the collaboration of John E. McKinney of the Rheology Section and Hans J. Oser of the Mathematical Analysis Section in the Institute for Basic Standards.[1]

TRANSIENT BEHAVIOR OF ACOUSTIC WAVES

Ordinarily acoustic propagation is stable. This means that the amplitudes diminish in the direction of propagation and the transient response vanishes after a sufficient time. Unstable propagation is tantamount to a "transient" response which increases without bound with time. The NBS scientists based their model for propagation on the Kirchhoff-Langevin equation, which implies that the accepted equations of motion, continuity, energy, and thermal conduction apply. They went a step further than previous work and obtained explicit approximations for the transient solutions, using Laplace transform theory.

The results of this analysis were evaluated for media having varied characteristics. Stability criteria were developed in terms of the following material properties: viscosity, thermal conductivity, and the heat capacities at constant pressure and constant volume. Stable propagation would occur when a defined inequality involving these properties holds true or at an isolated point where the ratio of the heat capacities, $\gamma = 1$. Media for which stable propagation would not be expected, according to these criteria, are the molten metals—such as mercury—and possibly superfluids.

Another consequence of this analysis is repudiation of the concept that propagation within an inviscid (zero viscosity) fluid takes place under conditions changing from adiabatic (no heat exchanges) to isothermal (maintained at constant temperature) with increasing frequency of the signal propagated. According to the analysis this type of variation does not exist with any stable fluid. Although the conditions are adiabatic at low frequencies, they do not vary continuously to isothermal at high frequencies as commonly assumed.

The regenerative, or unstable, situation is not found in reality, and these findings suggest that other propagation theories should be tested in like manner. Disobedience to the stability criteria for a medium suggests that the governing theory is incorrect or, more unlikely, that experimental values used to test stability criteria are in error.

[1] McKinney, J. E., and Oser, H. J., **Stability of acoustic waves within a viscous compressible heat-conducting fluid**, J. Acous. Soc. Am. 47, No. 3, Part 2, 781–785 (March 1970) and McKinney, J. E., and Oser, H. J., **Acoustic propagation and stability within an inviscid, heat-conducting fluid**, J. Res. NBS, Vol. 74B, No. 2, 67–84 (April 1970).

INTERLABORATORY *continued*

test for compression set. Sheets of vulcanized rubber will be distributed in March, June, September, and December 1971. The cost is $180.

Mooney viscosity. The subscriber will receive, probably in February, May, August, and November 1971, two 225-gram portions from each of two raw rubbers. Each portion is to be massed on a mill and tests made on each massed sample in accordance with ASTM D1646. The cost is $100.

A laboratory may subscribe to any or all of the testing programs. For laboratories subscribing to all four programs, the cost is $600. Laboratories wanting more information should write to:

Interlaboratory Programs for Rubber
Product Evaluation Technology Division
Room B360, Polymer Building
National Bureau of Standards
Washington, D.C. 20234

CONFERENCE & PUBLICATION *Briefs*

5TH MATERIALS RESEARCH SYMPOSIUM

The 5th Materials Research Symposium, *Solid State Chemistry*, will be held at NBS October 18–21, 1971. Sponsored by the Bureau's Institute for Materials Research, the meeting will emphasize the crystal-chemical and structural aspects of novel high temperature materials.

The symposium will deal, in particular, with those "novel" materials which have not been well characterized as to crystal chemical and other properties, such as melting points, crystal structure and equilibrium relations. Studies of syntheses and characterizations will be highlighted. Although emphasis will be on the experimental approach, discussion will be included on theoretical aspects of phase equilibrium and ordering of defects.

Of primary interest to the conference are fundamental studies on oxides and other chalcogenides, as well as borides, carbides, nitrides, silicides, and similar materials. Specifically excluded from the symposium subject matter are halides and ductile metals and alloys.

For more information, including a program and registration form, write to:

Dr. R. S. Roth
B214, Materials Building
National Bureau of Standards
Washington, D.C. 20234

ACM SYMPOSIUM

The Washington Chapter of the Association for Computing Machinery (ACM) will conduct its annual 1-day symposium at the National Bureau of Standards on June 24, 1971. Topics to be covered include: computer sciences in education, systems analysis and programming techniques, software systems, and systems evaluation, including software and hardware monitors and simulation. Registration begins at 8:15 a.m. at NBS, and the technical sessions begin at 9:00 a.m. Advance registration may be made by sending a check made payable to the Washington D.C. chapter/ACM to:

Miss Joyce Danzeisen
CACI
1815 N. Fort Meyer Drive
Arlington, Va. 22201

Preregistration fees are Student—$5; Member—$10; Non-member—$12; the fee for those registering on the day of the meeting will be $15. For further information call Mrs. Ethel Marden, (301) 921-3153, or Mrs. Anne Tenny, (301) 921-3391, or write to either one at the National Bureau of Standards, Washington, D.C. 20234.

SCHEDULED NBS-SPONSORED CONFERENCES

Each year NBS sponsors a number of conferences covering a broad range of topics in science and technology. The conferences listed below are either sponsored or cosponsored by NBS and will be held at the Bureau's Gaithersburg, Md., facility unless otherwise indicated. These conferences are open to all interested persons unless specifically noted. If no other address is given, inquiries should be sent to the person indicated below in care of Special Activities Section, Room A600, Administration Building, National Bureau of Standards, Washington, D.C. 20234.

Flow—Its Measurement and Control in Science and Industry. May 10–14. Cosponsors: American Institute of Physics; American Society of Mechanical Engineers; Instrument Society of America. Contact: V. J. Giardina, Instrument Society of America, 400 Stanwix Street, Pittsburgh, Pa. 15222. To be held in Pittsburgh, Pa.

Fourth Joint Meeting of Operations Researchers. May 24–26. Sponsors: College on Logistics of the Institute for Management Sciences (TIMS); Mathematical Society of America; American Society for Cybernetics; American Society for Public Administration; Association for Computing Machinery; Operations Research Society of America. Contact: Lloyd Burden (NBS Technical Analysis Division).

Summer Symposium in Analytical Chemistry. June 16–18. Cosponsor: American Chemical Society (Division of Analytical Chemistry). Contact: R. A. Durst (NBS Analytical Chemistry Division).

Fifth Symposium on Temperature Measurement and Control in Science and Industry. June 21–24. Cosponsors: American Institute of Physics; Instrument Society of America. Contact: H. H. Plumb (NBS Heat Division).

NBS Measurement Seminars, 1971 Series. Two- to four-day courses on measurement and calibration problems. Attendance limited. See September 1970 *Technical News Bulletin* for detailed information.

1970 NBS TECHNICAL HIGHLIGHTS

The 1970 NBS Technical Highlights [1] (NBS Special Pub. 340, $1.25, SD Catalog No. C13.10:340) summarizes the major technical accomplishments of NBS during the year ending June 30, 1970. The Highlights are introduced by an overview of NBS by its Director, Dr. L. M. Branscomb, followed by special sections on NBS and the Consumer, the Metric Study, Flammable Fabrics, Measures for Air Quality, and Building Technology. The outstanding accomplishments of each Institute and Center are then presented in capsule form, followed

by appendixes on staff, finances, publications, etc.

Specific highlights include:

- Construction of a one kilogram balance precise to a few parts per billion.
- Experimental use of color TV signals to transmit time signals.
- Development of a meter for quantifying hazardous radiation from microwave ovens and radar.
- NBS experts—and data on oxygen properties—helped determine cause of Apollo 13 explosion.
- Determination of oxygen in the atmosphere showed no content changes in 60 years.
- Development of instrument for making magnetocardiograms.

COMPILATION OF NBS PUBLICATIONS

Publications of the National Bureau of Standards 1968–69, by Betty L. Oberholtzer, NBS Special Publication 305–1, 497 pages, $4.50, is now available (SD Catalog No. C13.10:305 Suppl. 1).[1] This volume presents complete citations and abstracts, along with author/key word indexes, for all NBS publications issued during 1968–69. Full citations are also included for papers presented at NBS conferences that survey the "state-of-the-art" of a particular field.

[1] Order from the Superintendent of Documents, U.S. Government Printing Office, Washington D.C. 20402.

NBS Makes Its First Measurements of Transition Probabilities in VUV

THE BUREAU HAS ENTERED A NEW AREA OF RESEARCH, joining about half a dozen laboratories throughout the world in measuring transition probabilities in the vacuum ultraviolet (vuv) region of the spectrum. The first measurements were made on atomic oxygen [1] by William R. Ott of the Plasma Spectroscopy Section, using the Bureau's new 3-meter, high resolution, scanning monochromator and a wall-stabilized arc discharge as the light source. The accuracy of such measurements is important in determining the reliability of certain diagnostic techniques used in the study of high temperature plasmas produced both in the laboratory and in celestial bodies such as the sun. Oxygen was suggested for this first measurement because a discrepancy of a factor of 4 was found among other experiments, and because the transition probabilities are particularly significant in determining the mean density of oxygen in stars studied with rocket borne spectrometers.

The principal difficulty in determining transition probabilities in the vuv is producing in the arc a plasma which is optically thin (essentially no self absorption of vuv radiation) at the wavelengths of interest. In this experiment an argon arc operating at atmospheric pressure was used as the light source, with oxygen present at less than 1 part per million.

The new 3-meter, high resolution, scanning monochromator is coupled to a well-stabilized arc discharge being adjusted by William R. Ott. These instruments were used to measure transition probabilities of atomic oxygen.

Assuming the plasma to be in local thermodynamic equilibrium, transition probabilities were determined by measuring the following parameters: the arc temperature, the intensity of the emitting line, and the product of total number density of oxygen atoms and plasma length. The arc provided its own radiation standard for intensities in the vuv; blackbody intensities at the wavelengths of interest and at the known arc temperature were produced by slightly increasing the oxygen concentration so that the line centers were optically thick. The emitted intensity is then a function of temperature alone and is given by the Kirchhoff-Planck blackbody radiation law. The product of atom number density and plasma length was determined spectroscopically by comparing the intensity of the vuv oxygen line with the calibrated intensity of an oxygen line of known transition probability.

The results of this work are in excellent agreement with the majority of other theoretical and experimental results, and have revealed possible systematic errors in the experiments causing the discrepancy.

[1] For further details, see Ott, W. R. Measurement of transition probabilities for O I in the vacuum ultraviolet, Phys Rev., Vol. A-3, No. 6 (June 1971).

PUBLICATIONS of the National Bureau of Standards*

PERIODICALS

Technical News Bulletin, Annual Subscription: Domestic, $3; foreign, $4. Single copy price 30 cents. Available on a 1-, 2-, or 3-year subscription basis. SD Catalog No. C13.13:54.

Journal of Research of the National Bureau of Standards

Section A. Physics and Chemistry. Issued six times a year. Annual subscription: Domestic, $9.50; foreign, $11.75. Single copy price varies. SD Catalog No. C13.22/sec.A:74.

Section B. Mathematical Sciences. Issued quarterly. Annual subscription: Domestic, $5; foreign, $6.25. Single copy, $1.25. SD Catalog No. C13.22/sec.B:74.

Section C. Engineering and Instrumentation. Issued quarterly. Annual subscription: Domestic, $5; foreign, $6.25. Single copy, $1.25. SD Catalog No. C13.22/sec.C:74.

OTHER NBS PUBLICATIONS

Bullis, W. M., Baroody, A. J., Jr., Editors, Methods of measurement for semiconductor materials, process control, and devices, Quarterly Report, April 1 to June 30, 1970, Nat. Bur. Stand. (U.S.), Tech. Note 560, 58 pages (Nov. 1970) 60 cents, SD Catalog No. C13.46:560.

Durst, R. A., Editor, Electrochemical analysis section: Summary of activities—July 1969 to June 1970, Nat. Bur. Stand. (U.S.). Tech. Note 543, 92 pages (Nov. 1970) $1.00, SD Catalog No. C13.46:543.

Marsden, C. P., Editor, Silicon device processing. Proceedings of a Symposium held at Gaithersburg, Maryland, June 2–3, 1970, Nat. Bur. Stand. (U.S.), Spec. Publ. 337, 467 pages (Nov. 1970) $5.50, SD Catalog No. C13.10:337.

Marshak, H., Dove, R. B., A right angle ^{3}He cryostat incorporating a high field superconducting solenoid, Nat. Bur. Stand. (U.S.), Tech. Note 562, 22 pages (Dec. 1970) 30 cents, SD Catalog No. C13.46:562.

Menis, O., Editor, Status of thermal analysis. Proceedings of a Symposium on the Current Status of Thermal Analysis Held at Gaithersburg, Maryland, April 21–22, 1970, Nat. Bur. Stand. (U.S.), Spec. Publ. 338, 189 pages (Oct. 1970) $1.00, SD Catalog No. C13.10:338.

Moore, C. E., Selected tables of atomic spectra. A Atomic energy levels-second edition. B Multiplet tables. C I, C II, C III, C IV, C V, C VI. Data derived from the analyses of optical spectra, Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 3, Sec. 3, 71 pages (Nov. 1970) $1.00, SD Catalog No. C13.48:3/Sec. 3.

Napolitano, A., Hawkins, E. G., Standard Reference Materials: Viscosity of a standard borosilicate glass (Certification of Standard Reference Material 717), Nat. Bur. Stand. (U.S.), Spec. Publ. 260–23, 10 pages (Dec. 1970) 25 cents, SD Catalog No. C13.10:260–23.

Schaffer, R., Editor, Organic Chemistry Section: Summary of Activities, July 1969 to June 1970, Nat. Bur. Stand. (U.S.), Tech. Note 547, 134 pages (Nov. 1970) $1.25, SD Catalog No. C13.46:547.

Scribner, B. F., Editor, Activities of the NBS Spectrochemical Analysis Section, July 1969 to June 1970, Nat. Bur. Stand. (U.S.), Tech. Note 542, 114 pages (Nov. 1970) $1.25, SD Catalog No. C13.46:542.

Taylor, J. K., Editor, Microchemical Analysis Section: Summary of Activities, July 1969 to June 1970, Nat. Bur. Stand. (U.S.), Tech. Note 545, 126 pages (Dec. 1970) $1.25, SD Catalog No. C13.46:545.

U.S. Metric Study Report. International Standards, Nat. Bur. Stand. (U.S.), Spec. Publ. 345–1, 157 pages (Dec. 1970) $1.25, SD Catalog No. C13.10:345–1.

Yokel, F. Y., Mathey, R. G., Dikkers, R. D., Compressive strength of slender concrete masonry walls, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 33, 32 pages (Dec. 1970) 40 cents, SD Catalog No. C13.29/2:33.

PUBLICATIONS IN OTHER JOURNALS

This column lists all publications by the NBS staff, as soon after issuance as practical. For completeness, earlier references not previously reported may be included from time to time.

Adler, I., Walter, L. S., Lowman, P. D., Glass, B. P., French, B. M., Philpotts, J. A., Heinrich, K. F. J., Goldstein, J. I., Electron microprobe analysis of Apollo 11 lunar samples, Proc. Apollo 11 Lunar Science Conf., Houston, Tex., January 1970. Science 1, 87–92 (January 3, 1970).

Brauer, G. M., Huget, E. F., Termini, D. J., Plastic modified o-Ethoxybenzoic acid cements as temporary restorative materials, J. Dental Res. 49, No. 6, 1487–1494 (November–December 1970).

Davis, M. M., Bronsted acid-base behavior in "inert" organic solvents, Chapter 1 in The Chemistry of Nonaqueous Solvents, III, 1–135 (Academic Press Inc., New York, N.Y., 1970).

Dehl, R. E., Collagen: Mobile water content of frozen fibers, Science 170, 738–739 (November 13, 1970).

Durst, R. A., Pick an ion, any ion, Ind. Res. pp. 36–39 (November 1970). Evenson, K. M., Wells, J. S., Radford, H. E., Infrared resonance of OH with the H_2O laser: A galactic maser pump? Phys. Rev. Letters 25, No. 4, 199–202 (July 27, 1970).

Gills, T. E., Marlow, W. F., Thompson, B. A., Determination of trace elements in glass by activation analysis using hydrated antimony pentoxide for sodium removal, Anal. Chem. 42, 1831–1833 (December 1970).

Greenberg, L., Newman, M., Some results on solvable groups, Arch. Math. 21, No. 4, 349–352 (1970).

Grosch, H. R. J., A view of computers from the Bureau of Standards, Input 6, No. 2, 3–7 (1970).

Guttman, C. M., DiMarzio, E. A., Separation by flow. II. Application to gel permeation chromatography, Macromolecules 3, No. 5, 681–691 (September–October 1970).

Henderson, M., Berry, P. L., Progress of federal library automation, Drexel Library Quart. 6, Nos. 3 & 4, 249–263 (July–October 1970).

Hirshfeld, A. T., Hoppes, D. D., Transition mixing ratios determined from a study of the electron and gamma-ray distributions from oriented ^{193}Ir Phys. Rev. C 2, No. 6, 2341–2349 (December 1970).

Ledbetter, H. M., On the martensite crystallography of the cubic to orthorhombic transformation in Au-47.5 Cd, Scripta Met. 4, No. 11, 931–937 (November 1970).

Marshak, H., Langsford, A., Tamura, T., Wong, C. Y., Total neutron cross section of oriented ^{165}Ho from 2 to 135 MeV, Phys. Rev. C 2, No. 5, 1862–1881 (November 1970).

Meadow, C. T., Meadow, H. R., Organization, maintenance and search of machine files, Chapter 7 in Annual Review of Information Science and Technology, C. A. Cuadra, Ed., pp. 169–191 (Encyclopedia Britannica, Chicago, Ill., 1970).

Meshkov, S., Commentary on meson spectroscopy, Chapter in Experimental Meson Spectroscopy, C. Baltay and A. H. Rosenfeld, Ed., pp. 535–546 (Columbia Univ. Press, New York, N.Y., 1970).

Moore-Sitterly, C. E., Fundamental spectroscopic data, IAU Commission 14, August 1967 Meeting. Trans. Intern. Astron. Union 13A, 229–266 (1967).

Moore-Sitterly, C. E., Rare-earth spectra—the 1966 picture, Proc. First International Conf. Spectroscopy, Bombay, India, January 9–18, 1967, 1, 1–13 (1967).

Moore-Sitterly, C. E., Silicon in the sun, Chapter in Vistas in Astronomy (Commemoration of H. N. Russell) A. Beer, Ed., 12, 307–312 (Pergamon Press Inc., New York, N.Y., 1970).

Neill, A. H., Jr., High-energy light detector for use with pulsed ruby and glass lasers, Appl. Opt. 9, No. 10, 2392–2393 (October 1970).

**Publications with prices and SD Catalog numbers indicated may be purchased directly from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (foreign: one-fourth additional). NBS nonperiodical series are also available from the National Technical Information Service (NTIS) Springfield, Va. 22151. (formerly the Clearinghouse for Federal Scientific and Technical Information). Reprints from outside journals and the NBS Journal of Research may often be obtained directly from the authors.*

3-23-73
ILL

TN LEC AMF
MAYO CLINIC LIB
200 FIRST ST S W
ROCHESTER MN 55901

UNITED STATES
GOVERNMENT PRINTING OFFICE
PUBLIC DOCUMENTS DEPARTMENT
WASHINGTON, D.C. 20402

OFFICIAL BUSINESS

POSTAGE AND FEES PAID
U.S. GOVERNMENT PRINTING OFFICE

What Is The Commerce Department Doing For ME?

More than you may realize.

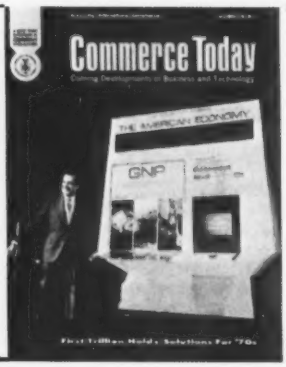
Until now, you've had no single source for a complete review of the services offered by Commerce's 20 agencies working in—

- **Foreign Trade**
- **Business Services**
- **Science, Technology**
- **Economic Development**
- **Business Economics**
- **Environment, Pollution Control**

Now, a new magazine, COMMERCE TODAY, gives you biweekly reports on current activity and coming developments in every field of business interest.

Keep up-to-date with new data for all areas of private enterprise of interest to you.

Return your reply NOW . . .



Mail to: U.S. Department of Commerce
Washington, D. C. 20230

C-42. 8:

Start sending me COMMERCE TODAY.

☐ Enclosed is my $20 check for the Superintendent of Documents.

☐ Charge my Deposit Account No. .....

Name .....

Address .....

City, State, ZIP .....